

COLLISION REPAIR: STRUCTURAL

COURSE DESCRIPTION

Collision Repair: Structural is a course that prepares students to analyze structural collision damage to a vehicle, determine the extent of the damage and the direction of impact, initiate an appropriate repair plan, and correctly use equipment to fit metal to a specified dimension within tolerances. Course content includes repairs to vehicle frames and glass. The course prepares students for entry level employment and advanced training in collision repair technology, and post secondary education. Students completing the *Collision Repair: Structural* are eligible to take the ASE written examination for Structural Analysis and Damage Repair.

Prerequisite(s):

Transportation Core

Algebra I or Math for Technology II; Physical Science or Principles of Technology I; Principles of Welding (100 hours) (may be concurrent)

Requirement:

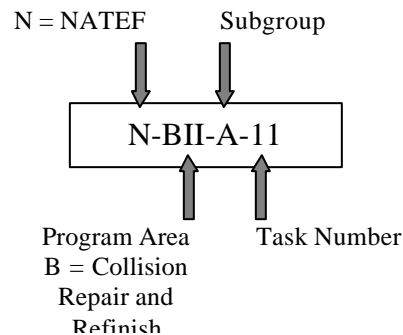
A minimum of 160 hours must be dedicated to structural analysis and damage repair and 100 hours in MIG welding to meet minimum standards set by NATEF.

Recommended Credits:

2

Recommended Grade Level(s): 11th, or 12th

Notes: Course is aligned with NATEF tasks list for Collision Repair and Refinish - Structural Analysis and Damage Repair. Items have been organized based on the requirements of the state-required course description format. NATEF tasks are referenced with the corresponding Performance Standards. Codes are as follows:



COLLISION REPAIR: STRUCTURAL STANDARDS

- 1.0 Students will demonstrate leadership, citizenship, and teamwork skills required for success in the school, community, and workplace.
- 2.0 Students will apply mathematics and science concepts to collision repair and refinish technology.
- 3.0 Students will properly inspect and repair damaged vehicle frames and glass.
- 4.0 Students will properly inspect, measure, and repair unibody vehicles.
- 5.0 Students will properly perform metal welding and cutting operations.
- 6.0 Students will demonstrate communication skills required in the collision repair and refinish industry.
- 7.0 Students will demonstrate interpersonal and employability skills required in the collision repair and refinish industry.
- 8.0 Students will demonstrate structural analysis and damage repair technology safety practices, including Occupational Safety and Health Administration (OSHA) and Environmental Protection Agency (EPA) requirements for a structural repair facility.

COLLISION REPAIR: STRUCTURAL

STANDARD 1.0

Students will demonstrate leadership, citizenship, and teamwork skills required for success in the school, community, and workplace.

LEARNING EXPECTATIONS

The student will:

- 1.1 Lead a team.
- 1.2 Participate in SkillsUSA-VICA as an integral part of classroom instruction.
- 1.3 Assess client complaint and apply problem-solving and decision-making skills to communicate with the client.
- 1.4 Demonstrate teamwork skills.

PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

- 1.1.A As a team leader, demonstrates character and leadership skills to accomplish a project.
- 1.1.B Evaluates the effectiveness of a team and develops a plan for improvement.
- 1.2.A Applies the points of the creed and purposes of SkillsUSA-VICA in the classroom and laboratory.
- 1.2.B Demonstrates rules of parliamentary procedure to express ideas to a group.
- 1.3.A Analyzes situations in the workplace and uses conflict resolution techniques to solve the problem.
- 1.3.B Follows work orders and communicates with client.
- 1.4 Participates in a group to diagnose electrical systems.

SAMPLE PERFORMANCE TASKS

- Analyze the classroom and laboratory structure. Compile a proposal to organize the classroom and laboratory to show improvement in effectiveness.
- Participate in various SkillsUSA-VICA programs and/or competitive events.
- Evaluate an activity within the school, community, and/or workplace and develop a plan for improvement using teamwork skills.
- Implement an annual program of work.
- Prepare a meeting agenda for a SkillsUSA-VICA monthly meeting.
- Attend a professional organization meeting or tradeshow relating to the automotive service industry.

INTEGRATION LINKAGES

SkillsUSA-VICA, *Professional Development Program*, SkillsUSA-VICA, Communications and Writing Skills, Teambuilding Skills, Research, Language Arts, Sociology, Psychology, Math, Math for Technology, Applied Communications, Social Studies, Problem Solving, Interpersonal Skills, Employability Skills, Critical-Thinking Skills, SCANS (Secretary's Commission on Achieving Necessary Skills), Chamber of Commerce, Colleges, Universities, Technology Centers, and Employment Agencies

State Board of Education Approved
February 2002

COLLISION REPAIR: STRUCTURAL

STANDARD 2.0

Students will apply mathematics and science concepts to collision repair and refinish technology.

LEARNING EXPECTATIONS

The student will:

- 2.1 Relate mathematics to structural analysis and damage repair technology.
- 2.2 Relate scientific concepts to structural analysis and damage repair technology.
- 2.3 Examine the materials and construction of vehicles.

PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

- 2.1.A Estimates the results of basic arithmetic operations, and accurately rounds up or down depending on the appropriate rule for the situations.
- 2.1.B Visually formulates an angle, (e.g. suspension system or drive belt) and verifies its conformance to the manufacturer's specified angle.
- 2.1.C Determines if the lines of an automobile are vertical or horizontal as specified in the original design specifications.
- 2.1.D Interprets symbols to determine compliance with the manufacturer's specifications.
- 2.1.E Solves equations using graphical, numerical, and algebraic methods.
- 2.1.F Distinguishes between Fahrenheit and centigrade temperature measurement devices and determines which to use for a specific situation.
- 2.1.G Diagnoses and measures structural damage using tram and self-centering gauges according to industry specifications. N-BI-A-1
- 2.2.A Correlates the following concepts with their role in automotive structural analysis and damage repair technology:
 - heat transfer
 - conduction
 - radiation
 - convection
 - expansion
 - contraction
 - force (in relation to realignment)
 - Newton's laws of motion
 - energy conversion
 - heat energy
 - the three states of matter
- 2.2.B Analyzes the characteristics, uses, and safety requirements of solvents used in an autobody environment.
- 2.2.C Examines the following automotive applications of acoustics:
 - how sound generated in one place in the body and engine can be carried to other parts of the engine through metal and other materials.
 - how the frequency of the sound relates to a normal or abnormally operating system.
 - why a specific noise sounds different depending on the acoustics of the vehicle.
 - what happens when an object resonates?
- 2.2.D Uses a scale to measure component weight in order to balance rotating systems.
- 2.2.E Illustrates how an applied force at one location can be transmitted via fluid pressure to provide a force at a remote location on the vehicle.
- 2.2.F Analyzes how heat affects the different strengths of metal.
- 2.3.F Compares the different types of construction for unibody and body-over-frame vehicles.

- 2.3.B Illustrates how vehicles are assembled and how net unit build and coining are used to fit body panels.
- 2.3.C Distinguishes the different types of materials used for vehicle construction.
- 2.3.D Assesses the importance of restoring vehicle dimensions.
- 2.3.E Examines how cams, pulleys, and levers are used to multiply force or transfer directions of force in a mechanical system.
- 2.3.F Characterizes new materials and the uses and characteristics of known materials.

SAMPLE PERFORMANCE TASKS

- Identify misaligned or damaged steering, suspension, and power train components which can cause vibration, steering, and wheel alignment problems, align or replace in accordance with vehicle manufacturer's recommendations.N-BI-11
- Diagram the construction of a body-over-frame vehicle.

INTEGRATION LINKAGES

Math, Science, Chemistry, Physics, Communication Skills, Teamwork Skills, Reading Skills, Leadership Skills, Problem Solving and Critical Thinking Skills, computer Skills, Art and Design, Computer Aided Design, Secretary's Commission on Achieving Necessary Skills (SCANS), National Institute for Automotive Service Excellence, (ASE) National Automotive Technician Education Foundation (NATEF), Occupational Safety and Health Administration (OSHA), Environmental Protection Agency (EPA), SkillsUSA-VICA

COLLISION REPAIR: STRUCTURAL

STANDARD 3.0

Students will properly inspect and repair damaged vehicle frames and glass.

LEARNING EXPECTATIONS

The student will:

- 3.1 Diagnose damage and misalignment.
- 3.2 Repair or replace damaged frame areas or components.
- 3.3 Remove and replace glass.

PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

- 3.1.A Diagnoses and measures structural damage using tram and self-centering gauges according to industry specifications. N-BI-A-1
- 3.1.B Identifies misaligned or damaged steering, suspension, and powertrain components that can cause vibration, steering, and wheel alignment problems. N-BI-A-11
- 3.2.A Attaches frame anchoring devices. N-BI-A-2
- 3.2.B Straightens and aligns the following:
 - mash (collapse) damage N-BI-A-3
 - sag damage N-BI-A-4
 - sidesway damage N-BI-A-5
 - twist damage N-BI-A-6
 - diamond frame damage N-BI-A-7
- 3.2.C Performs the following replacements and repairs:
 - Removes and replaces damaged frame horns, side rails, and cross members according to manufacturer's specifications/procedures. N-BI-A-8
 - Repairs or replaces weakened or cracked frame members in accordance with vehicle manufacturer's specifications/procedures. N-BI-A-10
- 3.2.D Restores corrosion protection to repaired or replaced frame areas. N-BI-A-9
- 3.2.E Aligns or replaces misaligned or damaged steering, suspension, and powertrain components that can cause vibration, steering, and wheel alignment problems in accordance with vehicle manufacturer's specifications/procedures. N-BI-A-11
- 3.2.F Identifies heat limitations in frame repair. N-BI-A-12
- 3.3.A Removes and replaces fixed glass (heated and non-heated) using manufacturer's specifications/procedures and recommended materials. N-BI-C-1
- 3.3.B Removes and replaces modular glass using manufacturer's specifications/procedures and recommended materials. N-BI-C-2

SAMPLE PERFORMANCE TASKS

- Diagnose bent frame rail and determine whether to repair or replace.
- Check alignment of steering components on a damaged vehicle and determine whether to align or replace.

INTEGRATION LINKAGES

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COLLISION REPAIR: STRUCTURAL

STANDARD 4.0

Students will properly inspect, measure, and repair unibody vehicles.

LEARNING EXPECTATIONS

The student will:

- 4.1 Analyze critical factors specific to unibody repair.
- 4.2 Diagnose unibody vehicle damage and misalignment.
- 4.3 Repair damage to unibody vehicles.

PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

- 4.1.A Comprehends that measuring, dimensioning, and tolerance limits in unibody vehicles are critical to repair of these vehicles. N-BI-B-NOTE
- 4.1.B Recognizes that suspension/steering mounting points and engine power train attaching points are critical to vehicle safety, handling, and performance. N-BI-B-NOTE
- 4.2.A Diagnoses misaligned or damaged steering, suspension, and powertrain components that can cause vibration, steering, and 4-wheel alignment problems; realigns or replaces in accordance with vehicle manufacturer's specifications/procedures. N-BI-B-1
- 4.2.B Diagnoses and analyzes unibody vehicle dimensions using a tram gauge. N-BI-B-2
- 4.2.C Determines and inspects the locations of all suspension, steering, and powertrain component attaching points on the body. N-BI-B-3
- 4.2.D Diagnoses and measures unibody vehicles using a dedicated (fixture) measuring system. N-BI-B-4
- 4.2.E Diagnoses and measures unibody vehicles using a universal measuring system (mechanical, electronic, laser). N-BI-B-5
- 4.2.F Determines the extent of the direct and indirect damage and the direction of impact; plans the methods and sequence of repair. N-BI-B-6
- 4.3.A Attaches body anchoring devices; removes or repositions components as necessary. N-BI-B-7
- 4.3.B Straightens and aligns the following:
 - cowl assembly N-BI-B-8
 - roof rails/headers and roof panels N-BI-B-9
 - hinge and lock pillars N-BI-B-10
 - body openings, floor pans, and rocker panels N-BI-B-11
 - quarter panels, wheelhouse assemblies, and rear body sections (including rails and suspension/powertrain mounting points) N-BI-B-12
 - front-end sections (aprons, strut towers, upper and lower rails, steering, and suspension/power train mounting points, etc.) N-BI-B-13
- 4.3.C Uses:
 - proper heat stress relief methods in high strength steel in accordance with manufacturer specifications/procedures. N-BI-B-14

- proper cold stress relief methods. N-BI-B-15
- 4.3.D Removes creases and dents using power tools and hand tools to restore damaged areas to proper contours and dimensions. N-BI-B-16
- 4.3.E Determines the extent of damage to structural steel body panels; repairs or replaces damaged sections of structural steel body panels in accordance with manufacturer's specifications/ procedures. N-BI-B-17, N-BI-B-18.
- 4.3.F Restores corrosion protection to repaired or replaced unibody structural areas. N-BI-B-19

SAMPLE PERFORMANCE TASKS

- Use power and hand tools to remove dent according to proper contours and dimensions.
- Give an example demonstrating why measuring, dimensioning, and tolerance limits are critical in unibody vehicle repair.

INTEGRATION LINKAGES

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COLLISION REPAIR: STRUCTURAL

STANDARD 5.0

Students will properly perform metal welding and cutting operations.

LEARNING EXPECTATIONS

The student will:

- 5.1 Prepare for welding and cutting operations.
- 5.2 Perform welding and cutting techniques.

PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

- 5.1.A Identifies weldable and non-weldable materials used in collision repair. N-BI-D-1
- 5.1.B Determines the correct welder type, electrode, wire type, diameter, and gas to be used in a specific welding situation. N-BI-D-4
- 5.1.C Sets up welding equipment and adjusts the welder to "tune" for proper electrode stickout, voltage, polarity, flow rate, and wire-feed speed required for the material being welded; determines work clamp (ground) location and attaches. N-BII-D-4, N-BI-D-5, N-BI-D-7.
- 5.1.D Stores, handles, and installs high-pressure gas cylinders. N-BI-D-6
- 5.1.E Protects the following:
 - Protects adjacent panels, glass, vehicle interior, etc. from welding and cutting operations. N-BI-D-9
 - Protects computers and other electronic control modules during welding procedures according to manufacturer's specifications. N-BI-D-10
- 5.1.F Cleans and prepares the metal to be welded, assures good metal fit-up, applies weld-through primer if necessary, and clamps as required. N-BI-D-11
- 5.2.A Makes the following determinations:
 - Determines the joint type (butt weld with backing, lap, etc.) for weld being made according to manufacturer's/industry specifications. N-BII-D-12
 - Determines the type of weld (continuous, butt weld with backing, plug, etc.) for each specific welding operation according to manufacturer's/industry specifications. N-BII-D-13
- 5.2.A Welds and cuts high-strength steel and other metals using manufacturer's procedures. N-BII-D-2
- 5.2.B Uses the proper angle of the gun to the joint and the direction of the gun travel for the type of weld being made in the flat, horizontal, vertical, and overhead positions. N-BII-D-8
- 5.2.C Performs the following welds: continuous, stitch, tack, plug, butt weld with backing, and lap joints. N-BII-D-14
- 5.2.D Performs destructive tests on each weld type. N-BII-D-15
- 5.2.E Identifies the causes of the following and makes necessary adjustments:
 - spits and sputters, burn through, lack of penetration, porosity, incomplete fusion, excessive spatter, distortion, and waviness of bead. N-BII-D-16
 - contact tip burn-back and failure of wire to feed. N-BII-D-17
- 5.2.F Identifies cutting process for different materials and locations in accordance with manufacturer's procedures; performs cutting operation. N-BII-D-18

SAMPLE PERFORMANCE TASKS

- Identify science concepts involved in welding equipment functions.
- Prepare work area for a welding operation.
- Perform a stitch weld.

INTEGRATION LINKAGES

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COLLISION REPAIR: STRUCTURAL

STANDARD 6.0

Students will demonstrate communication skills required in the collision repair and refinish industry.

LEARNING EXPECTATIONS

The student will:

- 6.1 Communicate and comprehend oral and written information typically occurring in the automotive collision repair and repair workplace.
- 6.2 Solve structural repair problems and make decisions using a logical process.
- 6.3 Use teamwork skills to accomplish goals, solve problems, and manage conflict within groups.

PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

- 6.1.A Interprets and uses written information in common job formats, such as tables, charts, and reference materials and manuals relating to structural repair for vehicles.
- 6.1.B Interprets and uses graphical information such as blueprints, electrical schematics, process control schematics, automotive flow diagrams, and other automotive diagrams.
- 6.1.C Uses electronic resources to obtain automotive information for use in structural repair.
- 6.1.D Analyzes information obtained from various sources to determine a diagnostic approach to structural repair.
- 6.1.E Communicates clearly and appropriately in oral and written form.
- 6.2.A Develops a hypothesis regarding the cause of a structural damage problem.
- 6.2.B Tests the hypothesis to determine the solution to the structural damage problem.
- 6.2.C Creates, evaluates, and revises as needed a plan to resolve a problem.
- 6.3.A Serves in each of the functional roles of a team.
- 6.3.B Resolves conflicts within a group.
- 6.3.C Demonstrates appropriate and positive examples of giving and accepting criticism.
- 6.3.D Modifies behavior or revises work based on appropriate criticism.
- 6.3.E Solves problems in cooperation with other members of a group.
- 6.3.F Evaluates the role of the structural analysis and damage repair technician within the organizational system.

SAMPLE PERFORMANCE TASKS

- Use reference materials to determine procedures for structural analysis and damage repair.
- Work as a team member to develop an analytical strategy.
- Use blueprints and diagrams to execute a task.

INTEGRATION LINKAGES

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Technician Education Foundation (NATEF), Occupational Safety and Health Administration (OSHA), Environmental Protection Agency (EPA), SkillsUSA-VICA

COLLISION REPAIR: STRUCTURAL

STANDARD 7.0

Students will demonstrate interpersonal and employability skills required in the collision repair and refinish industry.

LEARNING EXPECTATIONS

The student will:

- 7.1 Infer relationships between honesty, integrity, and organization and personal job success.
- 7.2 Demonstrate attitudes conducive to workplace success.
- 7.3 Maintain structural analysis and repair equipment in a neat and orderly work area.
- 7.4 Assess implications of cultural and religious diversity for classroom and workplace relationships.
- 7.5 Develop individual and team time management and work sequencing skills to increase productivity in structural damage diagnostics and repair.

PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

- 7.1.A Illustrates the concept of integrity.
- 7.1.B Assesses the potential impact of an individual's work ethic on an organizational system.
- 7.1.C Infers the relationship between organization and personal job success in electrical and electronics system servicing.
- 7.2.A Modifies behavior to increase productivity in the classroom, laboratory and workplace.
- 7.2.B Demonstrates awareness of activities occurring concurrently in the classroom and workplace.
- 7.3.A Keeps electrical and electronic equipment in a clean and organized work area.
- 7.3.B Maintains work area according to NATEF and OSHA standards.
- 7.3.C Recognizes the correlation between a clean orderly work environment and successful and efficient job in electrical and electronics systems servicing.
- 7.4.A Assesses benefits and predicts problems that may arise from diversity in work teams.
- 7.4.B Devises solutions to problems arising from gender, cultural, racial, and religious diversity.
- 7.5.A Assesses the benefits of incorporating time management principles into electrical and electronic system servicing.
- 7.5.B Displays time management and work sequencing skills in electrical and electronic system servicing.
- 7.5.C Demonstrates the ability to diagnose and repair electrical and electronic systems within manufacturers labor operation time.

SAMPLE PERFORMANCE TASKS

- Maintain an orderly work area.
- Lead a problem-solving team.
- Consistently arrive at class on time.

- Participate in an internship in a dealership or independent shop.
- Resolve an interpersonal conflict in the classroom.

- Using case scenarios follow strategy based diagnostic procedure to verify the complaint, define the problem, isolate the problem, validate the problem, make the repair, and test the repair. Complete a repair order using technical writing skills and calculate salary earnings based on the repair order description and manufacture allowances for each item on the work order. Calculate manufacturer labor operation time used in the diagnostic process.

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COLLISION REPAIR: STRUCTURAL

STANDARD 8.0

Students will demonstrate structural analysis and damage repair technology safety practices, including Occupational Safety and Health Administration (OSHA) and Environmental Protection Agency (EPA) requirements for a structural repair facility.

LEARNING EXPECTATIONS

The student will:

- 8.1 Determine the safe and correct approach to structural analysis and damage repair.
- 8.2 Use protective clothing and safety equipment.
- 8.3 Use fire protection equipment.
- 8.4 Follow OSHA and EPA regulations affecting collision repair technology.
- 8.5 Respond to safety communications.

PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

- 8.1.A Conforms to federal, state, and local regulations when handling, storing, and disposing of chemicals.
- 8.1.B Ensures proper ventilation for chemical use.
- 8.1.C Locates first aid supplies.
- 8.2.A Demonstrates proper usage of special safety equipment relating to structural repair.
- 8.2.B Selects and uses the appropriate protective clothing for a given task.
- 8.2.C Demonstrates the use of eye, ear, and respiratory protection.
- 8.3.A Distinguishes the proper fire extinguisher for each class of fire.
- 8.3.B Demonstrates the proper use of a fire extinguisher.
- 8.4.A Locates regulatory information.
- 8.4.B Extracts information from Material Safety Data Sheets.
- 8.4.C Passes with 100% accuracy a written examination relating specifically to structural analysis and damage repair safety issues.
- 8.4.D Passes with 100% accuracy a performance examination relating specifically to structural analysis and damage repair tools and equipment.
- 8.4.E Maintains a portfolio record of written safety examinations and equipment examinations for which the student has passed an operational checkout by the instructor.
- 8.4.F Complies with relevant regulations and standards.
- 8.5.A Incorporates manufacturer safety issues relating to structural repair.
- 8.5.B Complies with safety signs and symbols.

SAMPLE PERFORMANCE TASKS

- Assess the work area for safety hazards.
- Design a corrections program for identified hazards.
- Model the appropriate protective equipment for an assigned task.

INTEGRATION LINKAGES

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COLLISION REPAIR: STRUCTURAL

SAMPLING OF AVAILABLE RESOURCES

Enhanced Delivery I-Car Curriculum, I-CAR

Auto Collision Curriculum Guide, Instructional Materials Laboratory (IML), University of Missouri

Professional Automotive Collision Repair, 2nd Ed, Duffy, Delmar Publishing

Auto Body Repairing and Refinishing, Goodheart-Willcox, 2000.

Teacher Web resources:

Math/Science Web Site <http://enc.org>

National Science Teachers Association <http://www.nsta.org/store>

Center for Occupational Research and Development (CORD) <http://www.cord.org/>

Delmar International Thomson Learning <http://www.delmar.com/>

University of Missouri Instructional Materials Lab (IML)
<http://www.iml.coe.missouri.edu/>

Oklahoma Curriculum Instructional Materials Center (CIMC)
<http://www.okvotech.org/cimc/home.htm>